# CUNY SPS DATA 621 - CTG5 - HW4

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*April 24th, 2019*

## Contents

# 1 DATA EXPLORATION

In this assignment we explore, analyze and model a dataset containing 8,161 observations with 25 variables each representing a customer at an auto insurance company. Two of the 25 features are target varibles and 23 are predictors. One of the target variables, `TARGET_FLAG`, is a binary categorical variable where 1 indicates that the customer has been in a car crash and 0 indicates they have not. The other target, `TARGET_AMT`, is a continuous numerical variable representing the payout amoutn if the customer was in a car accident. Of the remaining 23 predictor variables, 13 are categorical and 10 are numerical.

We will build a logistic and multiple linear regression that will determine the followings: - Predict the probability that a person will crash their car - Predict the amount of money it will cost if the person does crash their car

We will be able to develop insurance rates based on a number of predictors such as income, age, distance to work, and how long they have been customers, etc.

In the training dataset, there are 23 predictors and 2 response variables - one is binary value that indicates whether claim was made and the other is numerical value indicating the cost of claim.

Table 1: Data Dictionary

| VARIABLE | DEFINITION | TYPE |
|---|---|---|
| TARGET_FLAG | car crash = 1, no car crash = 0 | binary categorical response |
| TARGET_AMT | car crash cost = >0, no car crash = 0 | continuous numerical response |
| AGE | driver's age - very young/old tend to be risky | continuous numerical predictor |
| BLUEBOOK | $ value of vehicle | continuous numerical predictor |
| CAR_AGE | age of vehicle | continuous numerical predictor |
| CAR_TYPE | type of car (6types) | categorical predictor |
| CAR_USE | usage of car (commercial/private) | binary categorical predictor |
| CLM_FREQ | number of claims past 5 years | discrete numerical predictor |
| EDUCATION | max education level (5types) | categorical predictor |
| HOMEKIDS | number of children at home | discrete numerical predictor |
| HOME_VAL | $ value of home - home owners tend to drive more responsibly | continuous numerical predictor |
| INCOME | $ income - rich people tend to get into fewer crashes | continuous numerical predictor |
| JOB | job category (8types, 1missing )- white collar jobs tend to be safer | categorical predictor |
| KIDSDRIV | number of driving children - teenagers likely get into crashes | discrete numerical predictor |
| MSTATUS | maritial status - married people drive more safely | catogerical predictor |
| MVR_PTS | number of traffic tickets | continuous numerical predictor |
| OLDCLAIM | $ total claims in the past 5 years | continuous numerical predictor |
| PARENT1 | single parent | binary categorical predictor |
| RED_CAR | a red car | binary categorical predictor |
| REVOKED | license revoked (past 7 years) - more risky driver | binary categorical predictor |
| SEX | gender - woman may have less crashes than man | binary categorical predictor |
| TIF | time in force - number of years being customer | continuous numerical predictor |
| TRAVTIME | distance to work | continuous numerical predictor |
| URBANCITY | urban/rural | binary categorical predictor |
| YOJ | years on job - the longer they stay more safe | continuous numerical predictor |

The response variable shows appropriate distribution in the training data. We confirm that for the number of target flags are 0 equals the target amount 0.

## 1.1 Summary Statistics

Table 2: (#tab:t2.1)Summary statistics

| | n | min | mean | median | max | sd |
|---|---|---|---|---|---|---|
| TARGET_AMT | 8161 | 0 | 1.504325e+03 | 0 | 107586.1 | 4.704027e+03 |
| AGE | 8155 | 16 | 4.479031e+01 | 45 | 81.0 | 8.627589e+00 |
| YOJ | 7707 | 0 | 1.049929e+01 | 11 | 23.0 | 4.092474e+00 |
| INCOME | 7716 | 0 | 6.189809e+04 | 54028 | 367030.0 | 4.757268e+04 |
| HOME_VAL | 7697 | 0 | 1.548673e+05 | 161160 | 885282.0 | 1.291238e+05 |
| TRAVTIME | 8161 | 5 | 3.348572e+01 | 33 | 142.0 | 1.590833e+01 |
| BLUEBOOK | 8161 | 1500 | 1.570990e+04 | 14440 | 69740.0 | 8.419734e+03 |
| TIF | 8161 | 1 | 5.351305e+00 | 4 | 25.0 | 4.146635e+00 |
| OLDCLAIM | 8161 | 0 | 4.037076e+03 | 0 | 57037.0 | 8.777139e+03 |
| MVR_PTS | 8161 | 0 | 1.695503e+00 | 1 | 13.0 | 2.147112e+00 |
| CAR_AGE | 7651 | 0 | 8.328715e+00 | 8 | 28.0 | 5.700066e+00 |

Table 3: (#tab:t2.2)Summary statistics

| | n | min | mean | median | max | sd |
|---|---|---|---|---|---|---|
| TARGET_FLAG | 8161 | 0 | 0.2638157 | 0 | 1 | 0.4407276 |
| PARENT1* | 8161 | 1 | 1.1319691 | 1 | 2 | 0.3384779 |
| SEX* | 8161 | 1 | 1.5360863 | 2 | 2 | 0.4987266 |
| MSTATUS* | 8161 | 1 | 1.4003186 | 1 | 2 | 0.4899929 |
| EDUCATION* | 8161 | 1 | 3.0906752 | 3 | 5 | 1.4448565 |
| JOB* | 8161 | 1 | 5.6871707 | 6 | 9 | 2.6818733 |
| CAR_TYPE* | 8161 | 1 | 3.5297145 | 3 | 6 | 1.9653570 |
| CAR_USE* | 8161 | 1 | 1.6288445 | 2 | 2 | 0.4831436 |
| RED_CAR* | 8161 | 1 | 1.2913859 | 1 | 2 | 0.4544287 |
| REVOKED* | 8161 | 1 | 1.1225340 | 1 | 2 | 0.3279216 |
| URBANICITY* | 8161 | 1 | 1.2045093 | 1 | 2 | 0.4033673 |
| KIDSDRIV* | 8161 | 1 | 1.1710575 | 1 | 5 | 0.5115341 |
| HOMEKIDS* | 8161 | 1 | 1.7212351 | 1 | 6 | 1.1163233 |
| CLM_FREQ* | 8161 | 1 | 1.7985541 | 1 | 6 | 1.1584527 |

Table 4: (#tab:t2.3)Summary statistics

| | TARGET_AMT | AGE | YOJ | INCOME | HOME_VAL | TRAVTIME | BLUEBOOK |
|---|---|---|---|---|---|---|---|
| | Min. : 0 | Min. :16.00 | Min. : 0.0 | Min. : 0 | Min. : 0 | Min. : 5.00 | Min. : 1500 |
| | 1st Qu.: 0 | 1st Qu.:39.00 | 1st Qu.: 9.0 | 1st Qu.: 28097 | 1st Qu.: 0 | 1st Qu.: 22.00 | 1st Qu.: 928 |
| | Median : 0 | Median :45.00 | Median :11.0 | Median : 54028 | Median :161160 | Median : 33.00 | Median :144 |
| | Mean : 1504 | Mean :44.79 | Mean :10.5 | Mean : 61898 | Mean :154867 | Mean : 33.49 | Mean :15710 |
| | 3rd Qu.: 1036 | 3rd Qu.:51.00 | 3rd Qu.:13.0 | 3rd Qu.: 85986 | 3rd Qu.:238724 | 3rd Qu.: 44.00 | 3rd Qu.:2085 |
| | Max. :107586 | Max. :81.00 | Max. :23.0 | Max. :367030 | Max. :885282 | Max. :142.00 | Max. :69740 |
| | NA | NA's :6 | NA's :454 | NA's :445 | NA's :464 | NA | NA |

Table 5: (#tab:t2.4)Summary statistics

| | TARGET_FLAG | PARENT1 | SEX | MSTATUS | EDUCATION | JOB | CAR_TYPE |
|---|---|---|---|---|---|---|---|
| | Min. :0.0000 | No :7084 | M :3786 | Yes :4894 | <High School :1203 | z_Blue Collar:1825 | Minivan :2145 |
| | 1st Qu.:0.0000 | Yes:1077 | z_F:4375 | z_No:3267 | Bachelors :2242 | Clerical :1271 | Panel Truck: 6 |
| | Median :0.0000 | NA | NA | NA | Masters :1658 | Professional :1117 | Pickup :1389 |
| | Mean :0.2638 | NA | NA | NA | PhD : 728 | Manager : 988 | Sports Car : 9 |
| | 3rd Qu.:1.0000 | NA | NA | NA | z_High School:2330 | Lawyer : 835 | Van : 750 |
| | Max. :1.0000 | NA | NA | NA | NA | Student : 712 | z_SUV :2294 |
| | NA | NA | NA | NA | NA | (Other) :1413 | NA |

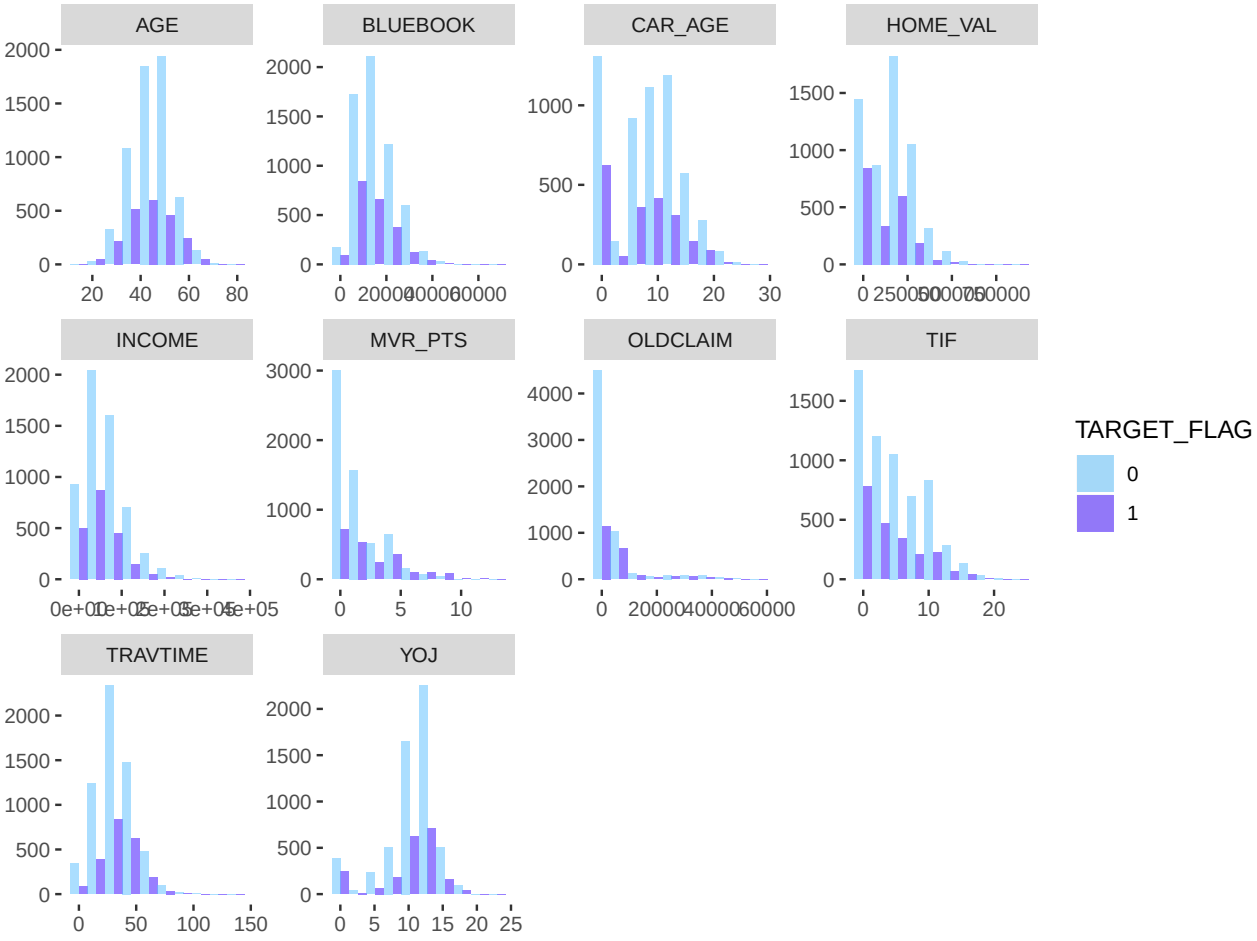



Figure 1: Numeric Data Distributions as a Function of TARGET_FLAG

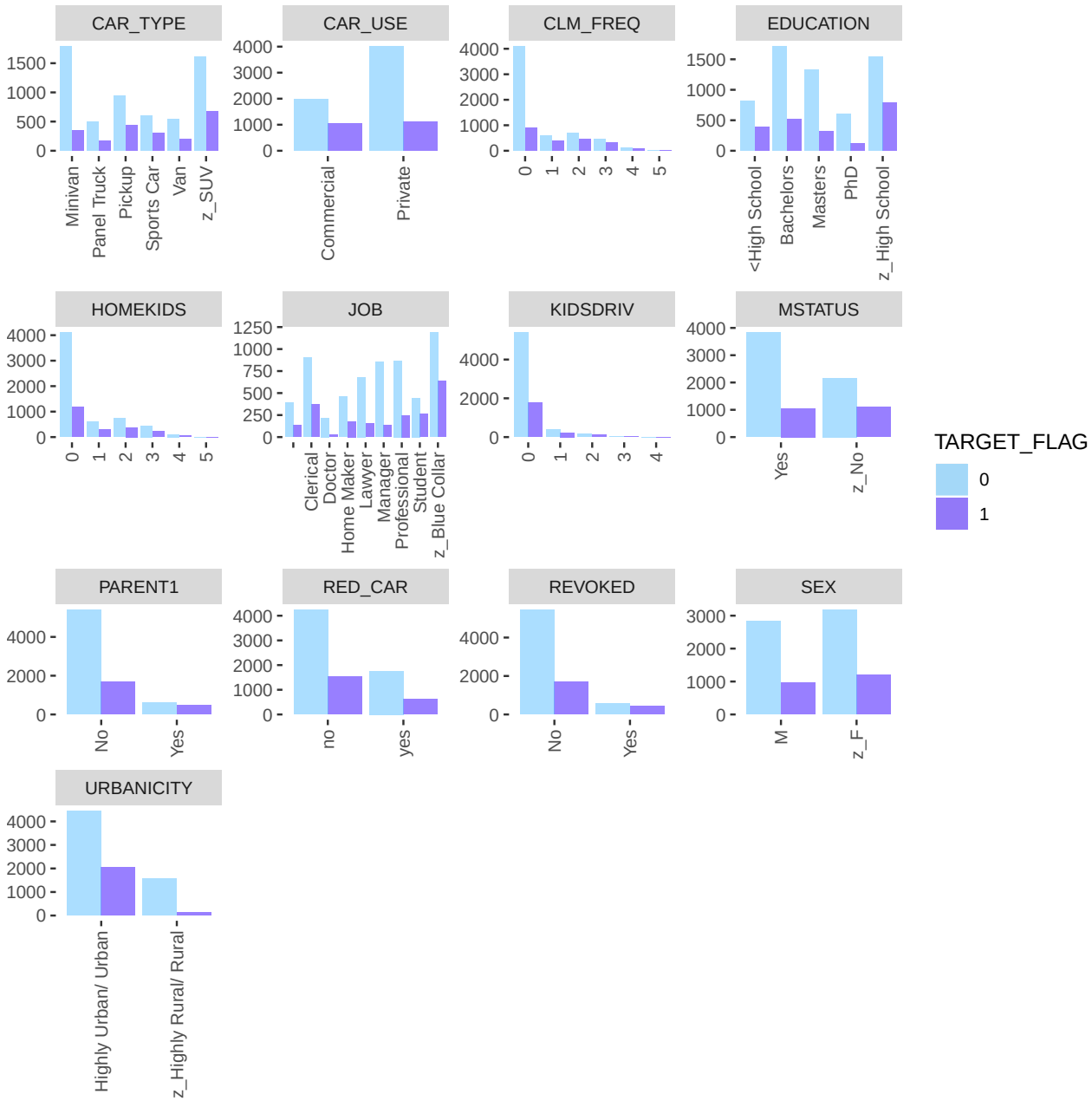



Figure 2: Categorical Data Distributions as a Function of TARGET_FLAG

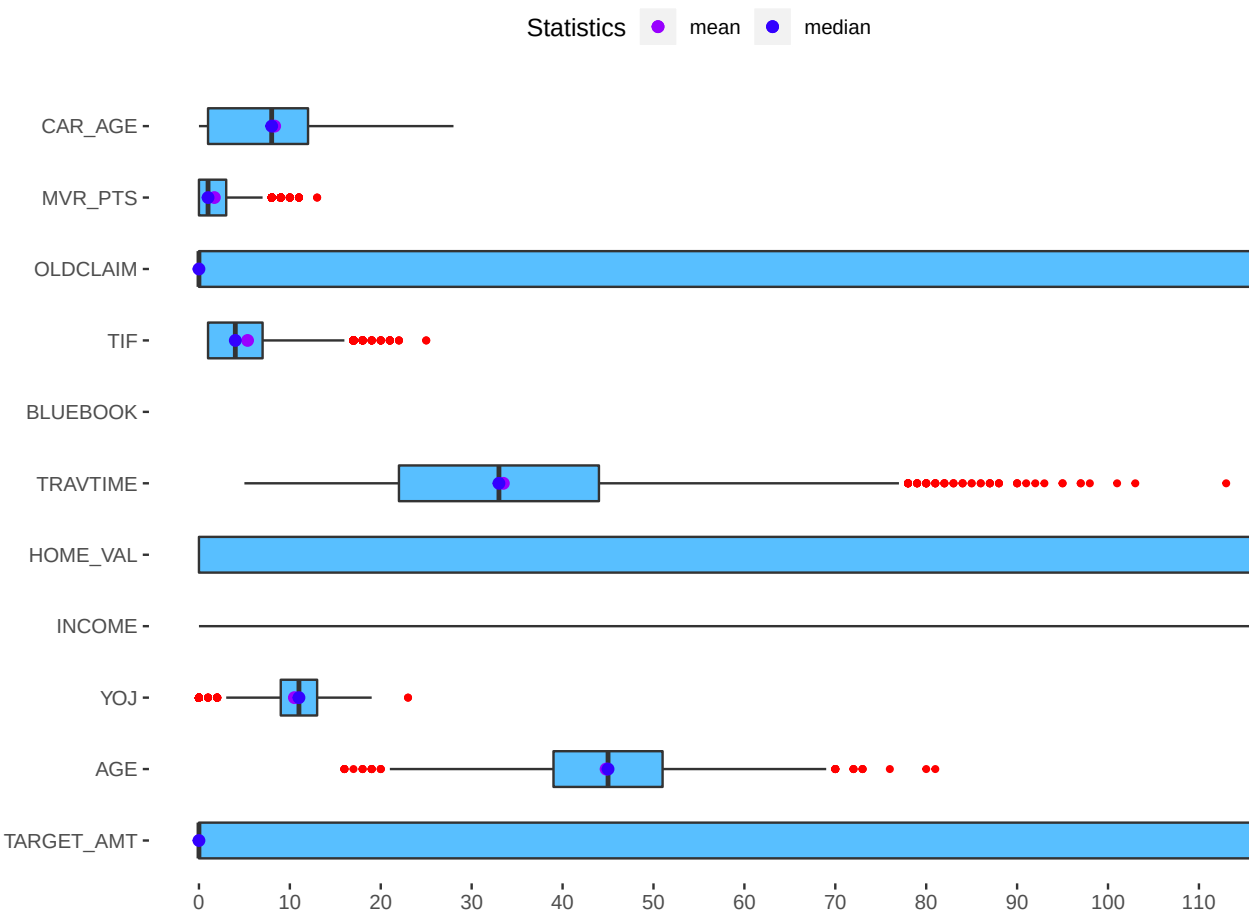



Figure 3: Outliers Boxplot

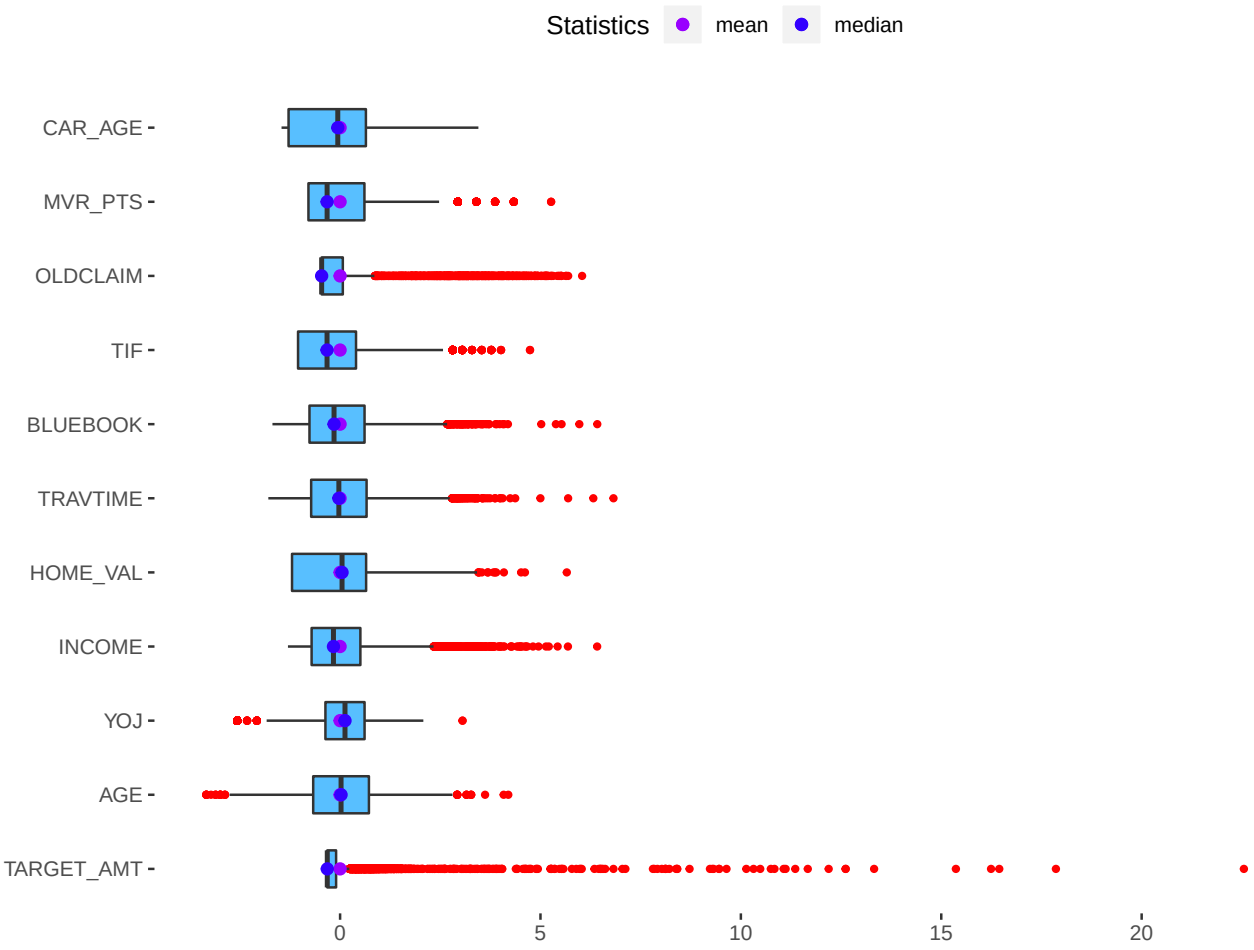



Figure 4: Scaled Boxplots

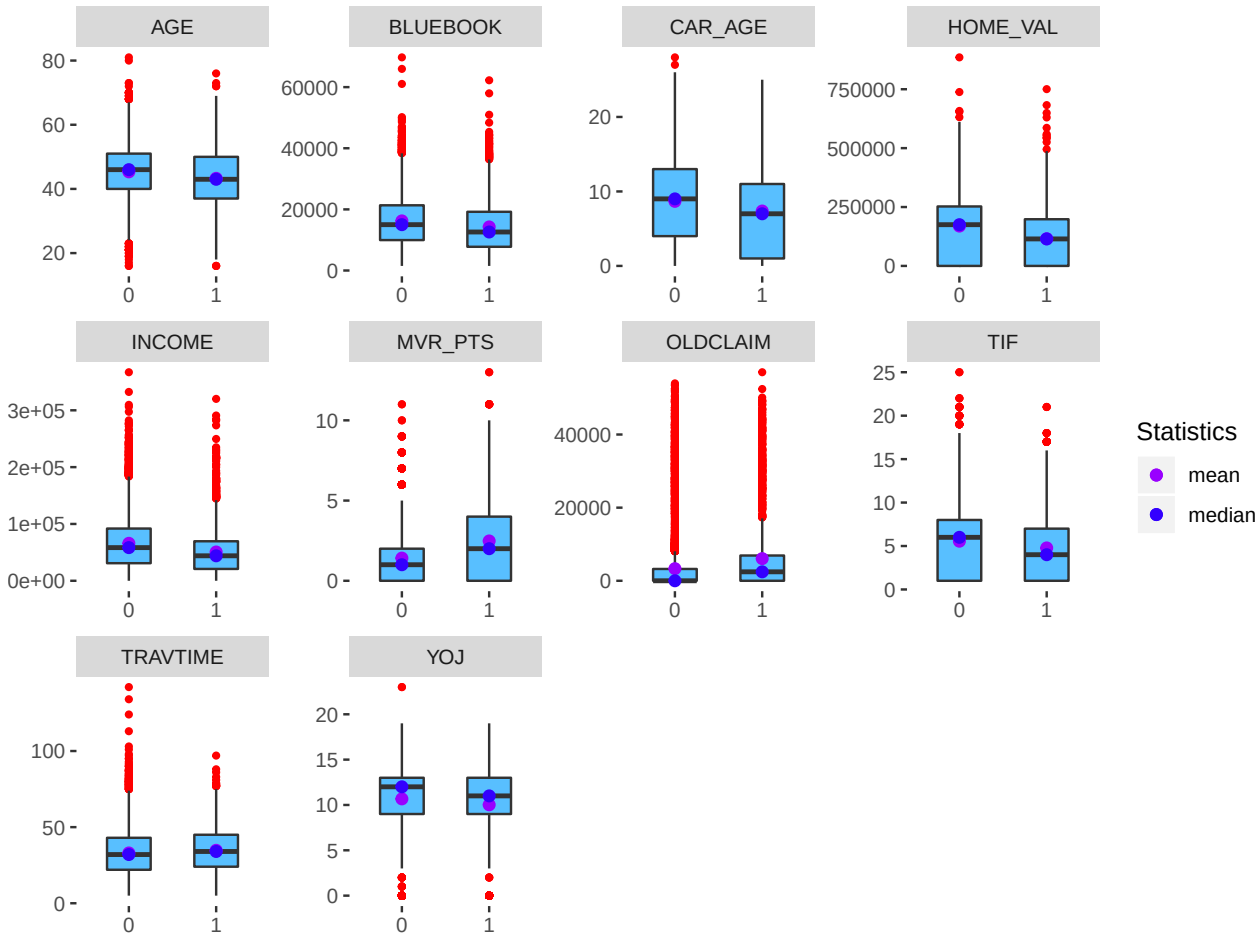



Figure 5: Linear relationship between each numeric predictor and the target

## 1.2 Linearity

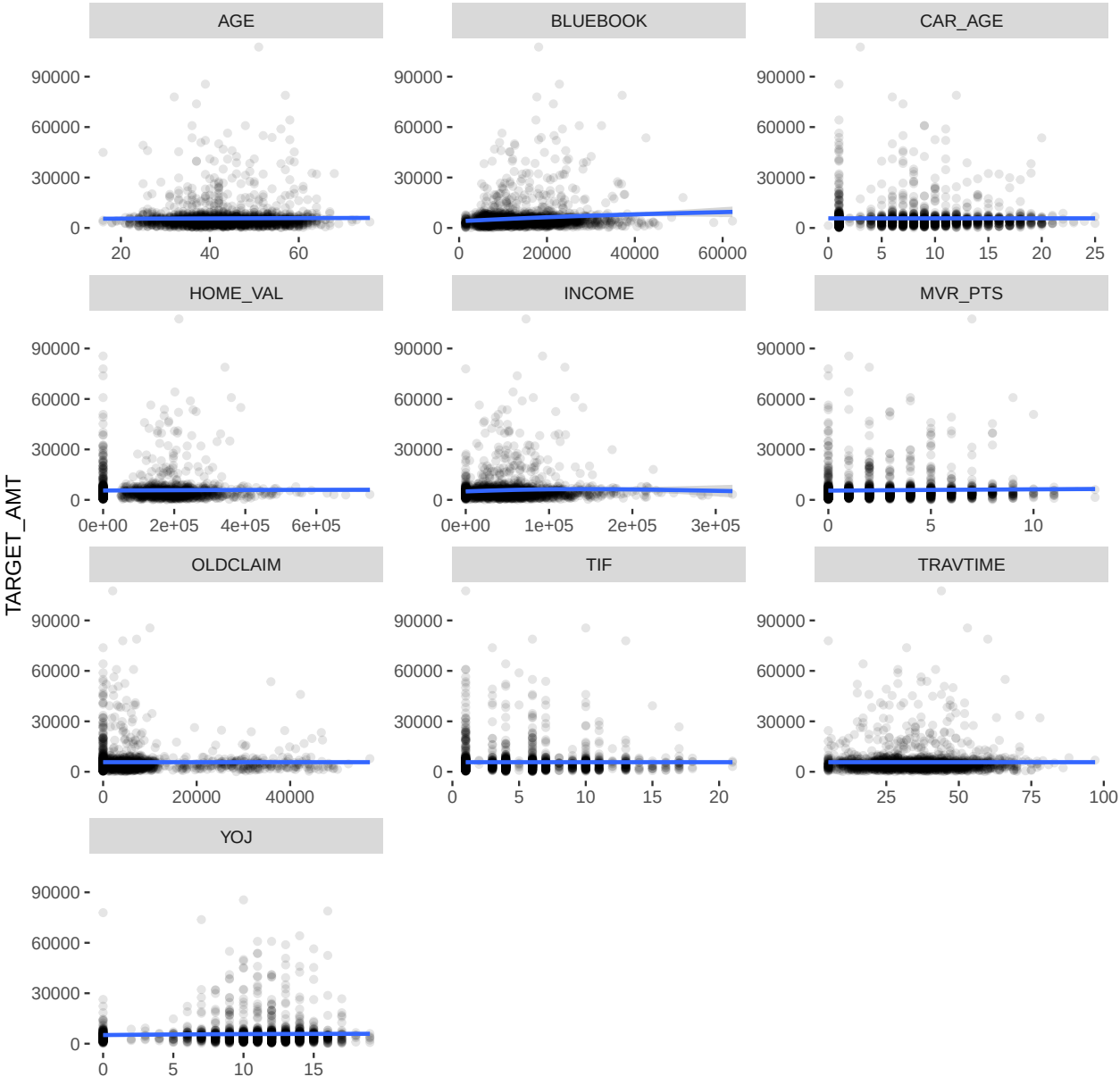



Figure 6: Scatter plot between Numeric Predictors and the TARGET_AMT

## 1.3 Missing Data

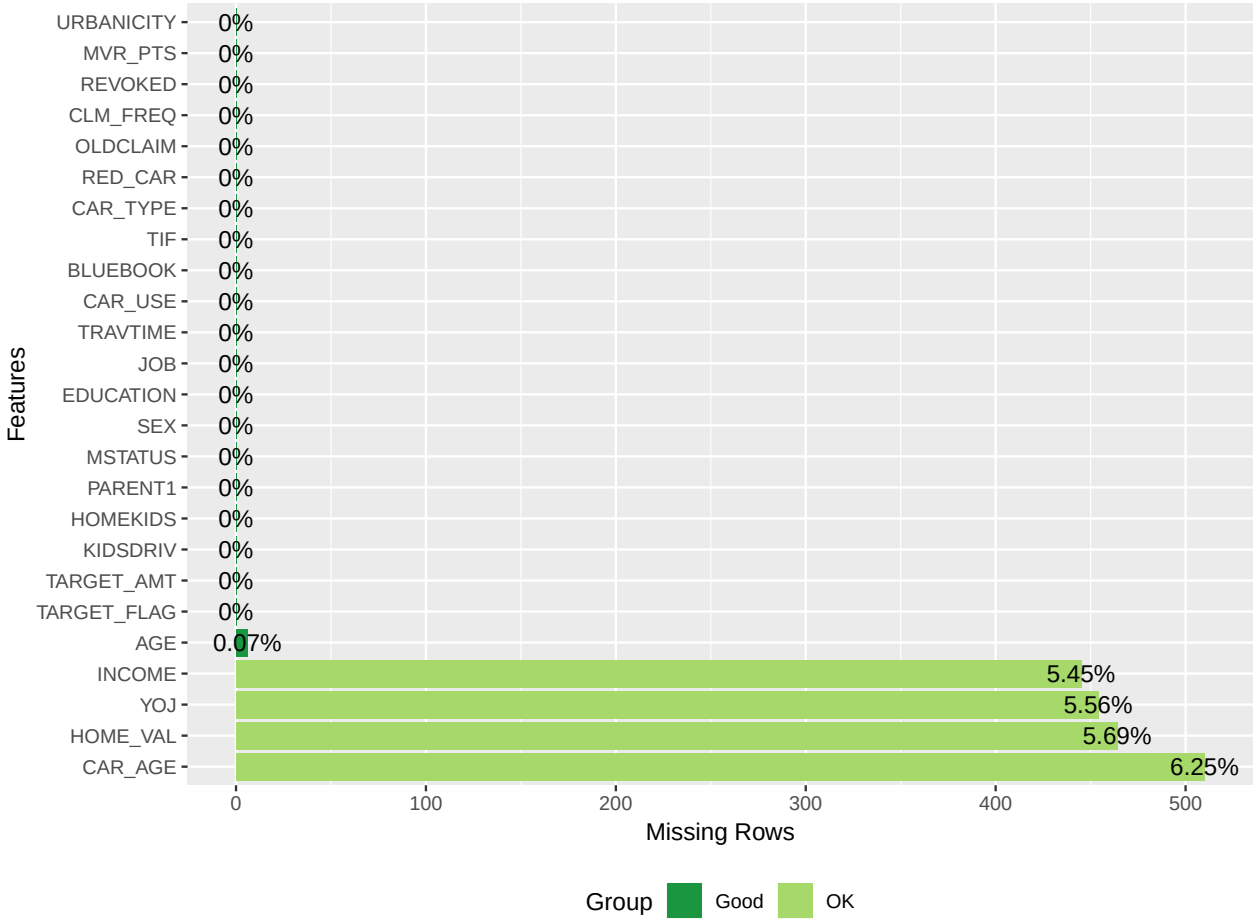



Figure 7: Missing data

There are a few missing data: `AGE`, `INCOME`, `YOJ`, `HOME_VAL`, `CAR_AGE`. Given the low proportion, it seems acceptable to impute the missing values.

# 2 DATA PREPARATION

## 2.1 Variable Desc

#### 2.1.0.1 KIDSDRIV

`KIDSDRIV` is a categorical predictor with values ranging from 0 to 4. It shows heavy skewness with most cars having 0 kid drivers. Judging from the distribution, it appears that having kid driver results in higher probability of making a claim.

#### 2.1.0.2 AGE

`AGE` presents driver's age and shows normal distribution, centered around 45. Looking at the boxplot of age, there is no difference between the claim made or not in distribution. Therefore, we can believe that `AGE` may not be helpful in determining the probability of making a claim.

#### 2.1.0.3 HOMEKIDS

`HOMEKIDS` is a predictor describing number of children at home ranging from 0 to 5.

#### 2.1.0.4 YOJ

`YOJ` is a predictor describing years on job. It is believed that people who stay at a job for a long time are usually more safe. YOJ shows normal distribution apart from those who are unemployed.

#### 2.1.0.5 INCOME

`INCOME` is a heavily skewed predictor variable. The outliers should be treated.

#### 2.1.0.6 HOME_VAL

`HOME_VAL` is a home value predictor variable. In theory, home owners tend to drive more responsibly. In the graph, we can see difference between the owners and renters.

#### 2.1.0.7 TRAVTIME

`TRAVTIME` is a predictor variable describing the distance to work. Long drives to work usually suggest greater risk. However the graph shows fairly normal distribution and it may not be helpful determining the probability of making a claim.

#### 2.1.0.8 BLUEBOOK

`BLUEBOOK` is a predictor variable describing the value of the car. The boxplot shows that the lower value of the car, the higher chances of making a claim. It is a possibility that the higher price cars are driven more carefully.

#### 2.1.0.9 TIF

`TIF` describes how long the customer has been with the company, and the longer they have, the safer it may be. The plots show the safe drivers tend to stay safe.

#### 2.1.0.10 OLDCLAIM

`OLDCLAIM` is a predictor describing the claims cost made in the past 5 years. We can see that it is very heavily skewed and that most people do not make claims.

#### 2.1.0.11 CLM_FREQ

`CLM_FREQ` is a predictor that describes claim costs in the past 5 years. It seems that people who have made a claim in the past 5 years are highly likely to make another claim.

#### 2.1.0.12 MVR_PTS

`MVR_PTS` is a predictor that describes motor vehicle record points. If you get lots of traffic tickets, you tend to get into more crash. It appears to be a highly significant variable as seen in boxplots.

#### 2.1.0.13 CAR_AGE

`CAR_AGE` describes the vehicle age. There is one data point that shows the vehicle age is -3, this will be corrected to 0.

#### 2.1.0.14 PARENT1

`PARENT1` describes single parent. This is factorized and renamed as `NumParents` to describe the number of parents.

#### 2.1.0.15 SEX

`SEX` describes the gender of the driver. This is factorized and renamed as `MALE` to describe male as 1 and female as 0. It does not appear to be significant variable in the box plot.

#### 2.1.0.16 MSTATUS

`MSTATUS` describes the martial status of the driver. It is believed that married people drive more safely. This variable has been factorized and renamed as `Single` to explain married as 0, not married as 1.

#### 2.1.0.17 EDUCATION

`EDUCATION` describes the education level of the driver. It is factorized. It may be correlated with INCOME.

#### 2.1.0.18 JOB

`JOB` describes the type of job the driver has. It is factorized. It may be correlated with INCOME. In theory white collar jobs tend to drive safer.

#### 2.1.0.19 CAR_TYPE

`CAR_TYPE` describes type of car. It is factorized.

#### 2.1.0.20 CAR_USE

`CAR_USE` describes how the car is used. Commercial vehicles are driven more and may increase probability of collision. It is factorized and renamed as `Commercial`. 0 means private.

#### 2.1.0.21 RED_CAR

`RED_CAR` describes the color of the car is red. It is believed that red cars, especially sports cars are riskier. It is factorized.

#### 2.1.0.22 REVOKED

`REVOKED` describes whether the license has revoked in the past 7 years. If it has revoked, it shows you are a risky driver. It is factorized. The boxplot shows the drivers who had lost their license are likely to be in accidents.

#### 2.1.0.23 URBANICITY

`URBANICITY` describes whether driver lives in Urban area or Rural area. It is factorized and renamed as `URBAN`. 0 means rural.

### 2.2 Missing values

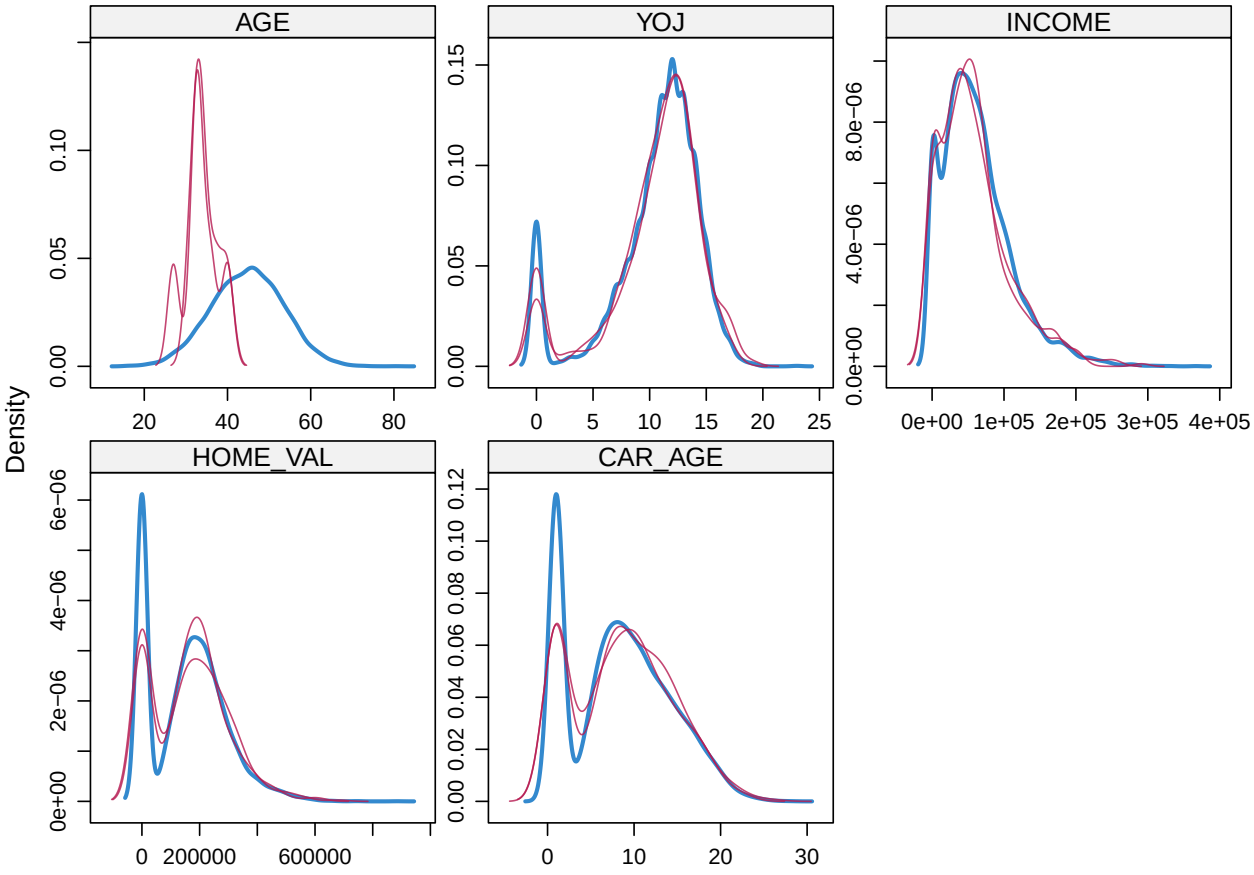
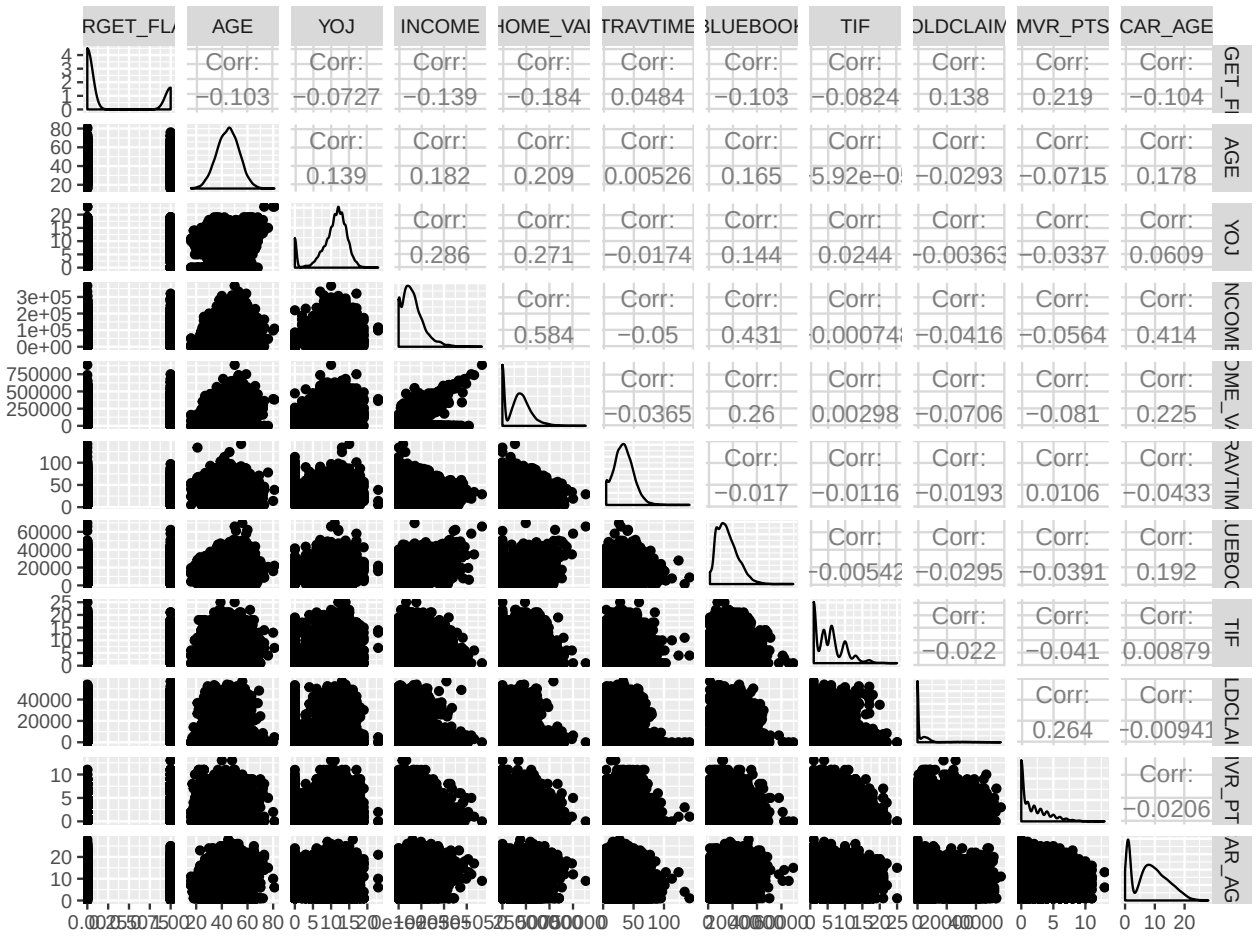
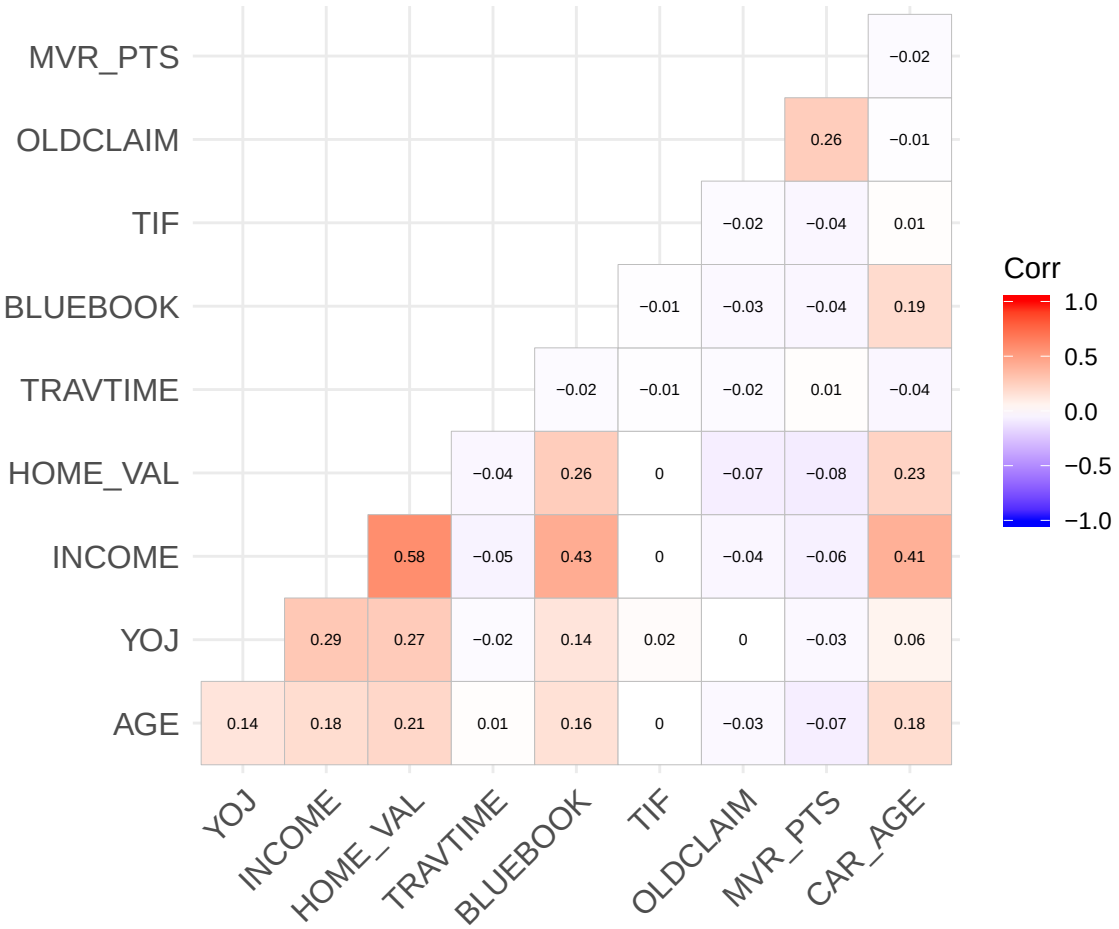



Figure 8: Difference between original and imputed data

We can see that excpet the `AGE`, the 4 variables roughly matches the existing distribution. We will use the 4 variables and impute `AGE` separately, using the median imputation.


RGET_FL
AGE
YOJ
INCOME
HOME_VAL
TRAVTIME
BLUEBOOK
TIF
OLDCLAIM
MVR_PTS
CAR_AGE
Corr: −0.103
Corr: −0.0727
Corr: −0.139
Corr: −0.184
Corr: 0.0484
Corr: −0.103
Corr: −0.0824
Corr: 0.138
Corr: 0.219
Corr: −0.104
Corr: 0.139
Corr: 0.182
Corr: 0.209
Corr: 0.00526
Corr: 0.165
Corr: −0.0293
Corr: −0.0715
Corr: 0.178
Corr: 0.286
Corr: 0.271
Corr: −0.0174
Corr: 0.144
Corr: 0.0244
Corr: −0.00363
Corr: −0.0337
Corr: 0.0609
Corr: 0.584
Corr: −0.05
Corr: 0.431
Corr: −0.0416
Corr: −0.0564
Corr: 0.414
Corr: −0.0365
Corr: 0.26
Corr: 0.00298
Corr: −0.0706
Corr: −0.081
Corr: 0.225
Corr: −0.017
Corr: −0.0116
Corr: −0.0193
Corr: 0.0106
Corr: −0.0433
Corr: −0.00542
Corr: −0.0295
Corr: −0.0391
Corr: 0.192
Corr: −0.022
Corr: −0.041
Corr: 0.00879
Corr: 0.264
Corr: −0.00941
Corr: −0.0206


MVR_PTS
OLDCLAIM
TIF
BLUEBOOK
TRAVTIME
HOME_VAL
INCOME
YOJ
AGE
YOJ
INCOME
HOME_VAL
TRAVTIME
BLUEBOOK
TIF
OLDCLAIM
MVR_PTS
CAR_AGE
Corr
1.0
0.5
0.0
−0.5
−1.0

# 3 BUILD MODELS

## 3.1 Model 1

___ TARGET_FLAG ~ NumParents+ Male+ EDUCATION+ JOB+ CAR_TYPE+ RED_CAR+ REVOKED+ Urban+ Single+ Commercial ___

Model 1 only includes categorical variables as this will be easily interpretable and comprehedible when measuring the leading customers.

```
##
## Call:
## NULL
##
## Deviance Residuals:
##       Min         1Q     Median         3Q        Max
## -0.002336   0.000000   0.000000   0.000000   0.003967
##
## Coefficients:
##                                  Estimate Std. Error z value Pr(>|z|)
## (Intercept)                      3.985e+02  3.339e+04   0.012    0.990
## TARGET_AMT                       1.517e+03  1.238e+04   0.123    0.902
## KIDSDRIV1                        3.310e-01  5.293e+02   0.001    1.000
## KIDSDRIV2                        2.015e-01  8.362e+02   0.000    1.000
## KIDSDRIV3                        2.806e+00  1.360e+02   0.021    0.984
## KIDSDRIV4                        1.104e+00  2.111e+03   0.001    1.000
## AGE                             -2.330e+00  3.161e+02  -0.007    0.994
## HOMEKIDS1                       -1.820e+00  1.299e+03  -0.001    0.999
## HOMEKIDS2                       -2.197e+00  5.524e+02  -0.004    0.997
## HOMEKIDS3                       -2.849e+00  4.647e+02  -0.006    0.995
## HOMEKIDS4                       -1.674e-01  6.208e+02   0.000    1.000
## HOMEKIDS5                       -3.108e+01  6.494e+03  -0.005    0.996
## YOJ                             -4.140e+00  5.194e+02  -0.008    0.994
## INCOME                          -1.598e+00  8.080e+02  -0.002    0.998
## PARENT1Yes                      -3.438e+00  9.584e+02  -0.004    0.997
## HOME_VAL                         4.646e+00  6.603e+02   0.007    0.994
## MSTATUSz_No                      3.277e+00  2.471e+02   0.013    0.989
## SEXz_F                          -2.317e+00  1.693e+03  -0.001    0.999
## EDUCATIONBachelors              -3.538e+00  8.074e+02  -0.004    0.997
## EDUCATIONMasters                -1.178e+00  2.617e+03   0.000    1.000
## EDUCATIONPhD                     2.305e+00  1.155e+03   0.002    0.998
## `EDUCATIONz_High School`         2.848e+00  3.617e+02   0.008    0.994
## JOBClerical                      6.795e+01  1.859e+04   0.004    0.997
## JOBDoctor                       -1.204e+01  1.413e+04  -0.001    0.999
## `JOBHome Maker`                  4.500e+01  1.378e+04   0.003    0.997
## JOBLawyer                        5.386e+01  1.545e+04   0.003    0.997
## JOBManager                       5.828e+01  1.675e+04   0.003    0.997
## JOBProfessional                  5.842e+01  1.774e+04   0.003    0.997
## JOBStudent                       5.081e+01  1.448e+04   0.004    0.997
## `JOBz_Blue Collar`               7.972e+01  2.136e+04   0.004    0.997
## TRAVTIME                        -1.795e+00  2.624e+02  -0.007    0.995
## CAR_USEPrivate                  -1.544e+00  3.026e+02  -0.005    0.996
## BLUEBOOK                        -1.704e+01  4.696e+02  -0.036    0.971
## TIF                              1.117e-01  2.902e+02   0.000    1.000
```

```
## `CAR_TYPEPanel Truck`              4.313e+00  1.097e+05   0.000    1.000
## CAR_TYPEPickup                     4.005e+00  2.989e+02   0.013    0.989
## `CAR_TYPESports Car`               3.446e+00  1.126e+03   0.003    0.998
## CAR_TYPEVan                        1.931e+00  1.306e+03   0.001    0.999
## CAR_TYPEz_SUV                     -2.796e+00  1.450e+03  -0.002    0.998
## RED_CARyes                        -3.173e+00  2.450e+02  -0.013    0.990
## OLDCLAIM                          -3.020e+00  2.528e+02  -0.012    0.990
## CLM_FREQ1                          6.016e+00  3.043e+02   0.020    0.984
## CLM_FREQ2                          4.471e+00  4.570e+02   0.010    0.992
## CLM_FREQ3                          6.357e+00  3.492e+02   0.018    0.985
## CLM_FREQ4                          2.695e+00  3.751e+02   0.007    0.994
## CLM_FREQ5                          1.594e+00  3.151e+03   0.001    1.000
## REVOKEDYes                         3.305e+00  3.385e+02   0.010    0.992
## MVR_PTS                            4.043e-01  2.033e+02   0.002    0.998
## CAR_AGE                            4.084e+00  4.377e+02   0.009    0.993
## `URBANICITYz_Highly Rural/ Rural` -3.120e+00  2.894e+02  -0.011    0.991
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 9.4180e+03  on 8160  degrees of freedom
## Residual deviance: 7.8951e-05  on 8111  degrees of freedom
## AIC: 100
##
## Number of Fisher Scoring iterations: 25
```

| Df | Deviance | AIC |
|---|---|---|
| | 7.54e+03 | 7.61e+03 |
| 1 | 7.54e+03 | 7.62e+03 |
| 1 | 7.54e+03 | 7.62e+03 |
| 1 | 7.62e+03 | 7.7e+03 |
| 4 | 7.58e+03 | 7.65e+03 |
| 8 | 7.65e+03 | 7.71e+03 |
| 5 | 7.67e+03 | 7.74e+03 |
| 1 | 7.61e+03 | 7.68e+03 |
| 1 | 7.54e+03 | 7.61e+03 |
| 1 | 7.62e+03 | 7.7e+03 |
| 1 | 8.11e+03 | 8.19e+03 |
| 4 | 7.58e+03 | 7.65e+03 |
| 5 | 7.55e+03 | 7.62e+03 |
| 5 | 7.67e+03 | 7.73e+03 |

```
##
## Call:  glm(formula = TARGET_FLAG ~ PARENT1 + SEX + MSTATUS + EDUCATION +
##     JOB + CAR_TYPE + CAR_USE + REVOKED + URBANICITY + KIDSDRIV +
##     HOMEKIDS + CLM_FREQ, family = "binomial", data = train.cat.a)
```

```
##
## Coefficients:
##                       (Intercept)                          PARENT1Yes
##                          -1.67704                             0.22946
##                            SEXz_F                         MSTATUSz_No
##                          -0.29536                             0.68680
##                EDUCATIONBachelors                   EDUCATIONMasters
##                          -0.50959                            -0.44619
##                       EDUCATIONPhD             EDUCATIONz_High School
##                          -0.51244                            -0.04203
##                       JOBClerical                           JOBDoctor
##                           0.61911                            -0.34245
##                     JOBHome Maker                           JOBLawyer
##                           0.73428                             0.18425
##                        JOBManager                     JOBProfessional
##                          -0.53115                             0.26883
##                        JOBStudent                   JOBz_Blue Collar
##                           0.76762                             0.44384
##               CAR_TYPEPanel Truck                      CAR_TYPEPickup
##                           0.17705                             0.61119
##                CAR_TYPESports Car                         CAR_TYPEVan
##                           1.23431                             0.43574
##                     CAR_TYPEz_SUV                      CAR_USEPrivate
##                           0.96012                            -0.75358
##                       REVOKEDYes  URBANICITYz_Highly Rural/ Rural
##                           0.73520                            -2.22199
##                        KIDSDRIV1                           KIDSDRIV2
##                           0.46309                             0.71031
##                        KIDSDRIV3                           KIDSDRIV4
##                           1.04833                             1.41075
##                        HOMEKIDS1                           HOMEKIDS2
##                           0.33702                             0.22791
##                        HOMEKIDS3                           HOMEKIDS4
##                           0.20653                             0.04099
##                        HOMEKIDS5                           CLM_FREQ1
##                           0.39726                             0.60717
##                        CLM_FREQ2                           CLM_FREQ3
##                           0.63789                             0.65232
##                        CLM_FREQ4                           CLM_FREQ5
##                           0.90748                             0.90022
##
## Degrees of Freedom: 8160 Total (i.e. Null);  8123 Residual
## Null Deviance:       9418
## Residual Deviance: 7537  AIC: 7613
```

AIC suggests that RED_CAR to be removed.

| | x |
|---|---|
| TARGET_AMT | 1.251637e+12 |
| KIDSDRIV1 | 2.286134e+09 |
| KIDSDRIV2 | 5.706117e+09 |
| KIDSDRIV3 | 1.508433e+08 |
| KIDSDRIV4 | 3.635061e+10 |
| AGE | 8.151835e+08 |
| HOMEKIDS1 | 1.377875e+10 |
| HOMEKIDS2 | 2.489638e+09 |
| HOMEKIDS3 | 1.762143e+09 |
| HOMEKIDS4 | 3.144953e+09 |
| HOMEKIDS5 | 3.441452e+11 |
| YOJ | 2.201709e+09 |
| INCOME | 5.327577e+09 |
| PARENT1Yes | 7.494753e+09 |
| HOME_VAL | 3.558199e+09 |
| MSTATUSz_No | 4.981112e+08 |
| SEXz_F | 2.339662e+10 |
| EDUCATIONBachelors | 5.319921e+09 |
| EDUCATIONMasters | 5.587443e+10 |
| EDUCATIONPhD | 1.087890e+10 |
| ‘EDUCATIONz_High School‘ | 1.067568e+09 |
| JOBClerical | 2.819527e+12 |
| JOBDoctor | 1.629913e+12 |
| ‘JOBHome Maker‘ | 1.550413e+12 |
| JOBLawyer | 1.946855e+12 |
| JOBManager | 2.289467e+12 |
| JOBProfessional | 2.567264e+12 |
| JOBStudent | 1.709784e+12 |
| ‘JOBz_Blue Collar‘ | 3.721698e+12 |
| TRAVTIME | 5.616486e+08 |
| CAR_USEPrivate | 7.472996e+08 |
| BLUEBOOK | 1.799763e+09 |
| TIF | 6.872163e+08 |
| ‘CAR_TYPEPanel Truck‘ | 9.816909e+13 |
| CAR_TYPEPickup | 7.289344e+08 |
| ‘CAR_TYPESports Car‘ | 1.035284e+10 |
| CAR_TYPEVan | 1.392500e+10 |
| CAR_TYPEz_SUV | 1.716795e+10 |
| RED_CARyes | 4.898158e+08 |
| OLDCLAIM | 5.215782e+08 |
| CLM_FREQ1 | 7.554543e+08 |
| CLM_FREQ2 | 1.703948e+09 |
| CLM_FREQ3 | 9.951044e+08 |
| CLM_FREQ4 | 1.147854e+09 |
| CLM_FREQ5 | 8.103965e+10 |
| REVOKEDYes | 9.348191e+08 |
| MVR_PTS | 3.373373e+08 |
| CAR_AGE | 1.563454e+09 |
| ‘URBANICITYz_Highly Rural/ Rural‘ | 6.834244e+08 |

### 3.2 Model 2

```
##
## Call:
## NULL
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -2.4441  -0.7140  -0.3890   0.6387   3.1624
##
## Coefficients:
##                                 Estimate Std. Error z value Pr(>|z|)
## (Intercept)                    -1.443177   0.035243 -40.949  < 2e-16
## KIDSDRIV1                       0.128119   0.030758   4.165 3.11e-05
## KIDSDRIV2                       0.129712   0.029737   4.362 1.29e-05
## KIDSDRIV3                       0.076376   0.027353   2.792 0.005235
## KIDSDRIV4                       0.024204   0.026065   0.929 0.353087
## AGE                             0.018708   0.036055   0.519 0.603854
## HOMEKIDS1                       0.104755   0.037286   2.809 0.004962
## HOMEKIDS2                       0.078502   0.040343   1.946 0.051669
## HOMEKIDS3                       0.064082   0.037511   1.708 0.087568
## HOMEKIDS4                       0.016715   0.030559   0.547 0.584398
## HOMEKIDS5                       0.025316   0.027381   0.925 0.355186
## YOJ                            -0.063748   0.034708  -1.837 0.066259
## INCOME                         -0.142104   0.053557  -2.653 0.007970
## HOME_VAL                       -0.177006   0.044946  -3.938 8.21e-05
## TRAVTIME                        0.232921   0.030049   7.751 9.08e-15
## BLUEBOOK                       -0.172962   0.044471  -3.889 0.000101
## TIF                            -0.229346   0.030596  -7.496 6.58e-14
## OLDCLAIM                       -0.181395   0.037007  -4.902 9.51e-07
## CLM_FREQ1                       0.188858   0.032566   5.799 6.66e-09
## CLM_FREQ2                       0.219296   0.033171   6.611 3.82e-11
## CLM_FREQ3                       0.181649   0.031298   5.804 6.48e-09
## CLM_FREQ4                       0.122420   0.026760   4.575 4.77e-06
## CLM_FREQ5                       0.050603   0.025835   1.959 0.050148
## MVR_PTS                         0.213395   0.030245   7.056 1.72e-12
## CAR_AGE                        -0.030012   0.042837  -0.701 0.483541
## PARENT1Yes                      0.081553   0.041047   1.987 0.046945
## SEXz_F                         -0.047429   0.050127  -0.946 0.344061
## EDUCATIONBachelors             -0.163096   0.052091  -3.131 0.001742
## EDUCATIONMasters               -0.089899   0.072814  -1.235 0.216962
## EDUCATIONPhD                   -0.031657   0.061856  -0.512 0.608801
## `EDUCATIONz_High School`        0.007688   0.043027   0.179 0.858198
## JOBClerical                     0.146069   0.071728   2.036 0.041708
## JOBDoctor                      -0.076154   0.045769  -1.664 0.096136
## `JOBHome Maker`                 0.057229   0.057140   1.002 0.316553
## JOBLawyer                       0.022619   0.051582   0.438 0.661026
## JOBManager                     -0.181171   0.056092  -3.230 0.001238
## JOBProfessional                 0.056492   0.061545   0.918 0.358668
## JOBStudent                      0.053378   0.061122   0.873 0.382499
## `JOBz_Blue Collar`              0.135750   0.077655   1.748 0.080444
## `CAR_TYPEPanel Truck`           0.147446   0.044731   3.296 0.000980
## CAR_TYPEPickup                  0.207081   0.037952   5.456 4.86e-08
## `CAR_TYPESports Car`            0.322708   0.040919   7.887 3.11e-15
```

```
## CAR_TYPEVan                          0.175084   0.036669   4.775 1.80e-06
## CAR_TYPEz_SUV                        0.342502   0.050165   6.828 8.64e-12
## REVOKEDYes                           0.314790   0.030527  10.312  < 2e-16
## `URBANICITYz_Highly Rural/ Rural`   -0.946502   0.045689 -20.716  < 2e-16
## MSTATUSz_No                          0.260945   0.043591   5.986 2.15e-09
## CAR_USEPrivate                      -0.365281   0.044466  -8.215  < 2e-16
##
## (Intercept)                         ***
## KIDSDRIV1                           ***
## KIDSDRIV2                           ***
## KIDSDRIV3                           **
## KIDSDRIV4
## AGE
## HOMEKIDS1                           **
## HOMEKIDS2                           .
## HOMEKIDS3                           .
## HOMEKIDS4
## HOMEKIDS5
## YOJ                                 .
## INCOME                              **
## HOME_VAL                            ***
## TRAVTIME                            ***
## BLUEBOOK                            ***
## TIF                                 ***
## OLDCLAIM                            ***
## CLM_FREQ1                           ***
## CLM_FREQ2                           ***
## CLM_FREQ3                           ***
## CLM_FREQ4                           ***
## CLM_FREQ5                           .
## MVR_PTS                             ***
## CAR_AGE
## PARENT1Yes                          *
## SEXz_F
## EDUCATIONBachelors                  **
## EDUCATIONMasters
## EDUCATIONPhD
## `EDUCATIONz_High School`
## JOBClerical                         *
## JOBDoctor                           .
## `JOBHome Maker`
## JOBLawyer
## JOBManager                          **
## JOBProfessional
## JOBStudent
## `JOBz_Blue Collar`                  .
## `CAR_TYPEPanel Truck`               ***
## CAR_TYPEPickup                      ***
## `CAR_TYPESports Car`                ***
## CAR_TYPEVan                         ***
## CAR_TYPEz_SUV                       ***
## REVOKEDYes                          ***
## `URBANICITYz_Highly Rural/ Rural`   ***
## MSTATUSz_No                         ***
```

```
## CAR_USEPrivate                    ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 9418.0  on 8160  degrees of freedom
## Residual deviance: 7262.7  on 8113  degrees of freedom
## AIC: 7358.7
##
## Number of Fisher Scoring iterations: 5
```

| Df | Deviance | AIC |
|---|---|---|
| | 7.26e+03 | 7.36e+03 |
| 4 | 7.3e+03 | 7.39e+03 |
| 1 | 7.26e+03 | 7.36e+03 |
| 5 | 7.27e+03 | 7.36e+03 |
| 1 | 7.27e+03 | 7.36e+03 |
| 1 | 7.27e+03 | 7.36e+03 |
| 1 | 7.28e+03 | 7.37e+03 |
| 1 | 7.32e+03 | 7.42e+03 |
| 1 | 7.28e+03 | 7.37e+03 |
| 1 | 7.32e+03 | 7.41e+03 |
| 1 | 7.29e+03 | 7.38e+03 |
| 5 | 7.33e+03 | 7.41e+03 |
| 1 | 7.31e+03 | 7.41e+03 |
| 1 | 7.26e+03 | 7.36e+03 |
| 1 | 7.27e+03 | 7.36e+03 |
| 1 | 7.26e+03 | 7.36e+03 |
| 4 | 7.28e+03 | 7.37e+03 |
| 8 | 7.32e+03 | 7.4e+03 |
| 5 | 7.35e+03 | 7.44e+03 |
| 1 | 7.37e+03 | 7.46e+03 |
| 1 | 7.87e+03 | 7.97e+03 |
| 1 | 7.3e+03 | 7.39e+03 |
| 1 | 7.33e+03 | 7.43e+03 |

```
##
## Call:  glm(formula = TARGET_FLAG ~ KIDSDRIV + YOJ + INCOME + HOME_VAL +
##     TRAVTIME + BLUEBOOK + TIF + OLDCLAIM + CLM_FREQ + MVR_PTS +
```

```
##     PARENT1 + EDUCATION + JOB + CAR_TYPE + REVOKED + URBANICITY +
##     MSTATUS + CAR_USE, family = "binomial", data = train)
##
## Coefficients:
##                      (Intercept)                          KIDSDRIV1
##                        -9.822e-01                          5.883e-01
##                         KIDSDRIV2                          KIDSDRIV3
##                         7.968e-01                          9.512e-01
##                         KIDSDRIV4                                YOJ
##                         1.352e+00                         -1.308e-02
##                            INCOME                           HOME_VAL
##                        -2.982e-06                         -1.411e-06
##                          TRAVTIME                           BLUEBOOK
##                         1.455e-02                         -2.292e-05
##                               TIF                           OLDCLAIM
##                        -5.511e-02                         -2.040e-05
##                         CLM_FREQ1                          CLM_FREQ2
##                         5.766e-01                          6.242e-01
##                         CLM_FREQ3                          CLM_FREQ4
##                         6.180e-01                          8.096e-01
##                         CLM_FREQ5                            MVR_PTS
##                         1.084e+00                          1.000e-01
##                       PARENT1Yes                 EDUCATIONBachelors
##                         4.391e-01                         -3.945e-01
##                  EDUCATIONMasters                       EDUCATIONPhD
##                        -2.867e-01                         -1.820e-01
##           EDUCATIONz_High School                        JOBClerical
##                         1.396e-02                          4.023e-01
##                         JOBDoctor                      JOBHome Maker
##                        -4.441e-01                          1.943e-01
##                         JOBLawyer                         JOBManager
##                         6.919e-02                         -5.648e-01
##                  JOBProfessional                         JOBStudent
##                         1.553e-01                          2.046e-01
##                  JOBz_Blue Collar                CAR_TYPEPanel Truck
##                         3.180e-01                          5.958e-01
##                   CAR_TYPEPickup                 CAR_TYPESports Car
##                         5.479e-01                          9.648e-01
##                      CAR_TYPEVan                       CAR_TYPEz_SUV
##                         6.375e-01                          7.034e-01
##                        REVOKEDYes  URBANICITYz_Highly Rural/ Rural
##                         9.582e-01                         -2.348e+00
##                      MSTATUSz_No                     CAR_USEPrivate
##                         4.464e-01                         -7.509e-01
##
## Degrees of Freedom: 8160 Total (i.e. Null);  8121 Residual
## Null Deviance:       9418
## Residual Deviance: 7273  AIC: 7353
```

AIC suggest to remove AGE, CAR_AGE and Male

| | x |
|---|---|
| KIDSDRIV1 | 7.719982 |
| KIDSDRIV2 | 7.215619 |
| KIDSDRIV3 | 6.105423 |
| KIDSDRIV4 | 5.543780 |
| AGE | 10.607503 |
| HOMEKIDS1 | 11.344522 |
| HOMEKIDS2 | 13.280597 |
| HOMEKIDS3 | 11.481685 |
| HOMEKIDS4 | 7.620150 |
| HOMEKIDS5 | 6.117701 |
| YOJ | 9.830064 |
| INCOME | 23.405693 |
| HOME_VAL | 16.484181 |
| TRAVTIME | 7.367812 |
| BLUEBOOK | 16.137666 |
| TIF | 7.638661 |
| OLDCLAIM | 11.175538 |
| CLM_FREQ1 | 8.653994 |
| CLM_FREQ2 | 8.978815 |
| CLM_FREQ3 | 7.993386 |
| CLM_FREQ4 | 5.843561 |
| CLM_FREQ5 | 5.446252 |
| MVR_PTS | 7.464283 |
| CAR_AGE | 14.973331 |
| PARENT1Yes | 13.748745 |
| SEXz_F | 20.503763 |
| EDUCATIONBachelors | 22.142077 |
| EDUCATIONMasters | 43.262830 |
| EDUCATIONPhD | 31.221788 |
| ‘EDUCATIONz_High School‘ | 15.106860 |
| JOBClerical | 41.982779 |
| JOBDoctor | 17.093387 |
| ‘JOBHome Maker‘ | 26.642116 |
| JOBLawyer | 21.711320 |
| JOBManager | 25.674234 |
| JOBProfessional | 30.908283 |
| JOBStudent | 30.485349 |
| ‘JOBz_Blue Collar‘ | 49.207538 |
| ‘CAR_TYPEPanel Truck‘ | 16.326806 |
| CAR_TYPEPickup | 11.753127 |
| ‘CAR_TYPESports Car‘ | 13.662746 |
| CAR_TYPEVan | 10.972163 |
| CAR_TYPEz_SUV | 20.534794 |
| REVOKEDYes | 7.604330 |
| ‘URBANICITYz_Highly Rural/ Rural‘ | 17.033548 |
| MSTATUSz_No | 15.505654 |
| CAR_USEPrivate | 16.134188 |

## 3.3 Model 3

##

```
## Call:
## NULL
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -2.4281  -0.7144  -0.3900   0.6398   3.1777
##
## Coefficients:
##                                  Estimate Std. Error z value Pr(>|z|)
## (Intercept)                      -1.44289    0.03524 -40.947  < 2e-16 ***
## KIDSDRIV1                         0.13058    0.03031   4.308 1.64e-05 ***
## KIDSDRIV2                         0.13181    0.02946   4.474 7.69e-06 ***
## KIDSDRIV3                         0.07750    0.02727   2.842 0.004477 **
## KIDSDRIV4                         0.02523    0.02584   0.976 0.328892
## HOMEKIDS1                         0.09539    0.03462   2.755 0.005871 **
## HOMEKIDS2                         0.06959    0.03778   1.842 0.065478 .
## HOMEKIDS3                         0.05547    0.03525   1.574 0.115556
## HOMEKIDS4                         0.01142    0.02940   0.389 0.697587
## HOMEKIDS5                         0.02386    0.02723   0.876 0.380972
## YOJ                              -0.05941    0.03414  -1.740 0.081787 .
## INCOME                           -0.14614    0.05348  -2.733 0.006280 **
## HOME_VAL                         -0.17407    0.04485  -3.881 0.000104 ***
## TRAVTIME                          0.23330    0.03003   7.769 7.93e-15 ***
## BLUEBOOK                         -0.18888    0.04001  -4.721 2.34e-06 ***
## TIF                              -0.22948    0.03059  -7.503 6.25e-14 ***
## OLDCLAIM                         -0.18139    0.03699  -4.903 9.41e-07 ***
## CLM_FREQ1                         0.18883    0.03256   5.799 6.68e-09 ***
## CLM_FREQ2                         0.21944    0.03316   6.617 3.66e-11 ***
## CLM_FREQ3                         0.18214    0.03129   5.821 5.84e-09 ***
## CLM_FREQ4                         0.12262    0.02675   4.583 4.58e-06 ***
## CLM_FREQ5                         0.05030    0.02587   1.944 0.051912 .
## MVR_PTS                           0.21281    0.03024   7.038 1.94e-12 ***
## PARENT1Yes                        0.08213    0.04102   2.002 0.045294 *
## EDUCATIONBachelors               -0.17538    0.04886  -3.590 0.000331 ***
## EDUCATIONMasters                 -0.11139    0.06529  -1.706 0.088004 .
## EDUCATIONPhD                     -0.04631    0.05769  -0.803 0.422151
## `EDUCATIONz_High School`          0.00517    0.04287   0.121 0.904015
## JOBClerical                       0.14373    0.07168   2.005 0.044943 *
## JOBDoctor                        -0.07390    0.04572  -1.616 0.106024
## `JOBHome Maker`                   0.05318    0.05680   0.936 0.349131
## JOBLawyer                         0.02433    0.05148   0.473 0.636408
## JOBManager                       -0.18007    0.05604  -3.214 0.001311 **
## JOBProfessional                   0.05646    0.06151   0.918 0.358678
## JOBStudent                        0.05249    0.06107   0.860 0.390063
## `JOBz_Blue Collar`                0.13486    0.07762   1.737 0.082311 .
## `CAR_TYPEPanel Truck`             0.16244    0.04179   3.887 0.000101 ***
## CAR_TYPEPickup                    0.20679    0.03791   5.454 4.92e-08 ***
## `CAR_TYPESports Car`              0.30294    0.03386   8.946  < 2e-16 ***
## CAR_TYPEVan                       0.18412    0.03543   5.196 2.04e-07 ***
## CAR_TYPEz_SUV                     0.31338    0.03881   8.074 6.78e-16 ***
## REVOKEDYes                        0.31476    0.03051  10.318  < 2e-16 ***
## `URBANICITYz_Highly Rural/ Rural` -0.94647    0.04569 -20.715  < 2e-16 ***
## MSTATUSz_No                       0.25943    0.04349   5.965 2.45e-09 ***
## CAR_USEPrivate                   -0.36513    0.04443  -8.218  < 2e-16 ***
```

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 9418.0  on 8160  degrees of freedom
## Residual deviance: 7264.5  on 8116  degrees of freedom
## AIC: 7354.5
##
## Number of Fisher Scoring iterations: 5
```

| Df | Deviance | AIC |
|---|---|---|
| | 7.26e+03 | 7.35e+03 |
| 4 | 7.3e+03 | 7.38e+03 |
| 5 | 7.27e+03 | 7.35e+03 |
| 1 | 7.27e+03 | 7.36e+03 |
| 1 | 7.27e+03 | 7.36e+03 |
| 1 | 7.28e+03 | 7.37e+03 |
| 1 | 7.33e+03 | 7.41e+03 |
| 1 | 7.29e+03 | 7.38e+03 |
| 1 | 7.32e+03 | 7.41e+03 |
| 1 | 7.29e+03 | 7.38e+03 |
| 5 | 7.33e+03 | 7.41e+03 |
| 1 | 7.31e+03 | 7.4e+03 |
| 1 | 7.27e+03 | 7.36e+03 |
| 4 | 7.29e+03 | 7.37e+03 |
| 8 | 7.32e+03 | 7.4e+03 |
| 5 | 7.37e+03 | 7.45e+03 |
| 1 | 7.37e+03 | 7.46e+03 |
| 1 | 7.87e+03 | 7.96e+03 |
| 1 | 7.3e+03 | 7.39e+03 |
| 1 | 7.33e+03 | 7.42e+03 |

```
##
## Call:  glm(formula = TARGET_FLAG ~ KIDSDRIV + YOJ + INCOME + HOME_VAL +
##     TRAVTIME + BLUEBOOK + TIF + OLDCLAIM + CLM_FREQ + MVR_PTS +
##     PARENT1 + EDUCATION + JOB + CAR_TYPE + REVOKED + URBANICITY +
##     MSTATUS + CAR_USE, family = "binomial", data = train)
##
## Coefficients:
##                     (Intercept)                         KIDSDRIV1
##                      -9.822e-01                         5.883e-01
```

```
##                      KIDSDRIV2                       KIDSDRIV3
##                      7.968e-01                       9.512e-01
##                      KIDSDRIV4                             YOJ
##                      1.352e+00                      -1.308e-02
##                         INCOME                        HOME_VAL
##                     -2.982e-06                      -1.411e-06
##                       TRAVTIME                        BLUEBOOK
##                      1.455e-02                      -2.292e-05
##                            TIF                        OLDCLAIM
##                     -5.511e-02                      -2.040e-05
##                      CLM_FREQ1                       CLM_FREQ2
##                      5.766e-01                       6.242e-01
##                      CLM_FREQ3                       CLM_FREQ4
##                      6.180e-01                       8.096e-01
##                      CLM_FREQ5                         MVR_PTS
##                      1.084e+00                       1.000e-01
##                     PARENT1Yes                EDUCATIONBachelors
##                      4.391e-01                      -3.945e-01
##                EDUCATIONMasters                     EDUCATIONPhD
##                     -2.867e-01                      -1.820e-01
##          EDUCATIONz_High School                      JOBClerical
##                      1.396e-02                       4.023e-01
##                      JOBDoctor                   JOBHome Maker
##                     -4.441e-01                       1.943e-01
##                      JOBLawyer                       JOBManager
##                      6.919e-02                      -5.648e-01
##                JOBProfessional                       JOBStudent
##                      1.553e-01                       2.046e-01
##                JOBz_Blue Collar              CAR_TYPEPanel Truck
##                      3.180e-01                       5.958e-01
##                  CAR_TYPEPickup               CAR_TYPESports Car
##                      5.479e-01                       9.648e-01
##                     CAR_TYPEVan                     CAR_TYPEz_SUV
##                      6.375e-01                       7.034e-01
##                      REVOKEDYes  URBANICITYz_Highly Rural/ Rural
##                      9.582e-01                      -2.348e+00
##                     MSTATUSz_No                  CAR_USEPrivate
##                      4.464e-01                      -7.509e-01
##
## Degrees of Freedom: 8160 Total (i.e. Null);  8121 Residual
## Null Deviance:       9418
## Residual Deviance: 7273  AIC: 7353
```

| | x |
|---|---|
| KIDSDRIV1 | 7.495313 |
| KIDSDRIV2 | 7.083295 |
| KIDSDRIV3 | 6.066746 |
| KIDSDRIV4 | 5.447691 |
| HOMEKIDS1 | 9.782557 |
| HOMEKIDS2 | 11.646107 |
| HOMEKIDS3 | 10.138444 |
| HOMEKIDS4 | 7.054505 |
| HOMEKIDS5 | 6.050739 |
| YOJ | 9.508996 |
| INCOME | 23.335243 |
| HOME_VAL | 16.414733 |
| TRAVTIME | 7.358960 |
| BLUEBOOK | 13.060424 |
| TIF | 7.633984 |
| OLDCLAIM | 11.166587 |
| CLM_FREQ1 | 8.652728 |
| CLM_FREQ2 | 8.973892 |
| CLM_FREQ3 | 7.988530 |
| CLM_FREQ4 | 5.840954 |
| CLM_FREQ5 | 5.462976 |
| MVR_PTS | 7.459405 |
| PARENT1Yes | 13.732822 |
| EDUCATIONBachelors | 19.476277 |
| EDUCATIONMasters | 34.788815 |
| EDUCATIONPhD | 27.161546 |
| ‘EDUCATIONz_High School‘ | 14.998438 |
| JOBClerical | 41.924381 |
| JOBDoctor | 17.056386 |
| ‘JOBHome Maker‘ | 26.322206 |
| JOBLawyer | 21.624062 |
| JOBManager | 25.621481 |
| JOBProfessional | 30.874901 |
| JOBStudent | 30.429519 |
| ‘JOBz_Blue Collar‘ | 49.163798 |
| ‘CAR_TYPEPanel Truck‘ | 14.248140 |
| CAR_TYPEPickup | 11.730468 |
| ‘CAR_TYPESports Car‘ | 9.356915 |
| CAR_TYPEVan | 10.245672 |
| CAR_TYPEz_SUV | 12.291240 |
| REVOKEDYes | 7.594472 |
| ‘URBANICITYz_Highly Rural/ Rural‘ | 17.034479 |
| MSTATUSz_No | 15.435664 |
| CAR_USEPrivate | 16.108458 |

### 3.4 Model 4

| | |
|---|---|
| Observations | 8161 |
| Dependent variable | TARGET_FLAG |
| Type | Generalized linear model |
| Family | binomial |
| Link | logit |

| | |
|---|---|
| $\chi^2(35)$ | 2140.47 |
| Pseudo-$R^2$ (Cragg-Uhler) | 0.34 |
| Pseudo-$R^2$ (McFadden) | 0.23 |
| AIC | 7349.49 |
| BIC | 7601.75 |

# 4 SELECT MODELS

| | Est. | S.E. | z val. | p | VIF |
|---|---|---|---|---|---|
| (Intercept) | 2.04 | 0.79 | 2.57 | 0.01 | NA |
| KIDSDRIV1 | 0.58 | 0.11 | 5.54 | 0.00 | 1.15 |
| KIDSDRIV2 | 0.82 | 0.15 | 5.40 | 0.00 | 1.15 |
| KIDSDRIV3 | 0.98 | 0.30 | 3.25 | 0.00 | 1.15 |
| KIDSDRIV4 | 1.38 | 1.12 | 1.23 | 0.22 | 1.15 |
| log(AGE) | -0.31 | 0.16 | -2.00 | 0.05 | 1.26 |
| YOJ | 0.01 | 0.01 | 1.30 | 0.19 | 2.37 |
| log(INCOME + 1e-14) | -0.02 | 0.00 | -4.07 | 0.00 | 3.23 |
| HOME_VAL | -0.00 | 0.00 | -5.25 | 0.00 | 1.75 |
| log(TRAVTIME) | 0.41 | 0.05 | 7.94 | 0.00 | 1.03 |
| log(BLUEBOOK) | -0.32 | 0.06 | -5.87 | 0.00 | 1.48 |
| TIF | -0.05 | 0.01 | -7.34 | 0.00 | 1.01 |
| log(OLDCLAIM + 1e-14) | 0.01 | 0.00 | 6.24 | 0.00 | 1.26 |
| MVR_PTS | 0.10 | 0.01 | 7.09 | 0.00 | 1.24 |
| PARENT1Yes | 0.37 | 0.10 | 3.66 | 0.00 | 1.64 |
| EDUCATIONBachelors | -0.41 | 0.11 | -3.75 | 0.00 | 7.47 |
| EDUCATIONMasters | -0.33 | 0.16 | -2.04 | 0.04 | 7.47 |
| EDUCATIONPhD | -0.30 | 0.19 | -1.53 | 0.13 | 7.47 |
| EDUCATIONz_High School | 0.03 | 0.09 | 0.35 | 0.73 | 7.47 |
| JOBClerical | 0.49 | 0.19 | 2.53 | 0.01 | 26.60 |
| JOBDoctor | -0.39 | 0.27 | -1.48 | 0.14 | 26.60 |
| JOBHome Maker | 0.15 | 0.21 | 0.69 | 0.49 | 26.60 |
| JOBLawyer | 0.16 | 0.17 | 0.96 | 0.34 | 26.60 |
| JOBManager | -0.51 | 0.17 | -2.99 | 0.00 | 26.60 |
| JOBProfessional | 0.22 | 0.18 | 1.26 | 0.21 | 26.60 |
| JOBStudent | 0.12 | 0.22 | 0.55 | 0.58 | 26.60 |
| JOBz_Blue Collar | 0.39 | 0.19 | 2.10 | 0.04 | 26.60 |
| CAR_TYPEPanel Truck | 0.54 | 0.14 | 3.76 | 0.00 | 2.33 |
| CAR_TYPEPickup | 0.58 | 0.10 | 5.80 | 0.00 | 2.33 |
| CAR_TYPESports Car | 0.96 | 0.11 | 8.85 | 0.00 | 2.33 |
| CAR_TYPEVan | 0.65 | 0.12 | 5.32 | 0.00 | 2.33 |
| CAR_TYPEz_SUV | 0.74 | 0.09 | 8.57 | 0.00 | 2.33 |
| REVOKEDYes | 0.71 | 0.08 | 8.82 | 0.00 | 1.01 |
| URBANICITYz_Highly Rural/ Rural | -2.35 | 0.11 | -20.86 | 0.00 | 1.14 |
| MSTATUSz_No | 0.46 | 0.08 | 5.62 | 0.00 | 1.96 |
| CAR_USEPrivate | -0.75 | 0.09 | -8.18 | 0.00 | 2.46 |

Standard errors: MLE

# 5 Appendix

The appendix is available as script.R file in `project4_insurance` folder.

https://github.com/betsyrosalen/DATA_621_Business_Analyt_and_Data_Mining